Ultra-Lightweight, Ultra-Stable RoboSiC Additively Manufactured Lasercom Telescope, Phase I

Completed Technology Project (2018 - 2019)

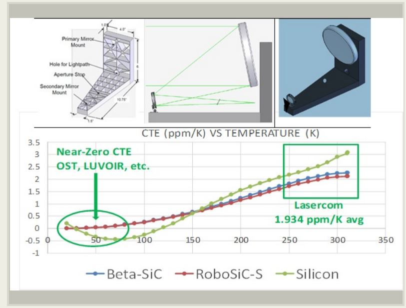
Project Introduction

Of interest to JPL, GRC and GSFC are laser communications telescopes (LCTs) with 30 to 100 cm clear aperture, wavefront error (WFE) less than 62 nm, cumulative WFE and transmission loss not to exceed 3-dB in the far field, advanced thermal and stray light design for operation while sun-pointing (3-degrees from the edge of the sun); -20° C to 50° C operational range (wider range preferred), and areal density <65kg/m^2. Telescope dimensional stability, low scatter, extreme lightweighting, and precision structures are a common theme across the NASA 2017 Physics of the Cosmos and Cosmic Origins Program Annual Technology Reports. Multiple Priority technology gaps can be found that require a solution in time for the next Decadal Survey. A common cited solution of interest is silicon carbide and 3D printing or additive manufacturing. RoboSiC technologies provide both. Team GT proposes purposefully engineered 2nd Generation optical-grade and structural-grade "RoboSiC to provide the degree of passive athermality required for the laser communications telescope wavefront error stability, concomitant with low areal density mirrors (7.75-10 kg/m^2) and structures (4-5 kg/m^2), and the ability to perform active precision adjustment (if required). The combination of 3D/AM allows the possibility to manufacture high structural efficiency classical truss structures such as the Pratt, Warren and Howe trusses and our gradient lattice cores for the mirrors. Clever design provides the additional stability benefit of damping during slew. We will use a combination of 3D/AM parts to produce inexpensive, bolt-together, athermal telescopes which achieve optical pathlength and wavefront error stability with low-scatter. A Paul-Baker three-mirror anastigmatic telescope may be an ideal laser communications telescope design. We plan to deliver mirror and structures coupons to NASA for testing.

Anticipated Benefits

NASA requires lasercom telescopes for space missions in multiple domains: >100 gigabit/s cislunar (Earth or lunar orbit to ground), >10 gigabit/s Earth-sun L1 and L2, >1 gigabit/s per AU-squared deep space, and >100 megabit/s planetary lander to orbiter. Other NASA missions that can benefit from our technology include eLISA and future Gravity Wave Observatories, future FIR (Origins Space Telescope), LUVOIR and HabEx missions.

Potential non-NASA applications include commercial free space communications, complex telescopes for Astronomy, Imaging and Remote Sensing applications, optical instruments/telescopes which enable imaging, surveillance, and reconnaissance missions for the military, police and paramilitary units, fire fighters, power and pipeline monitoring, search and rescue, atmospheric and ocean monitoring, and high-energy laser beam directors.



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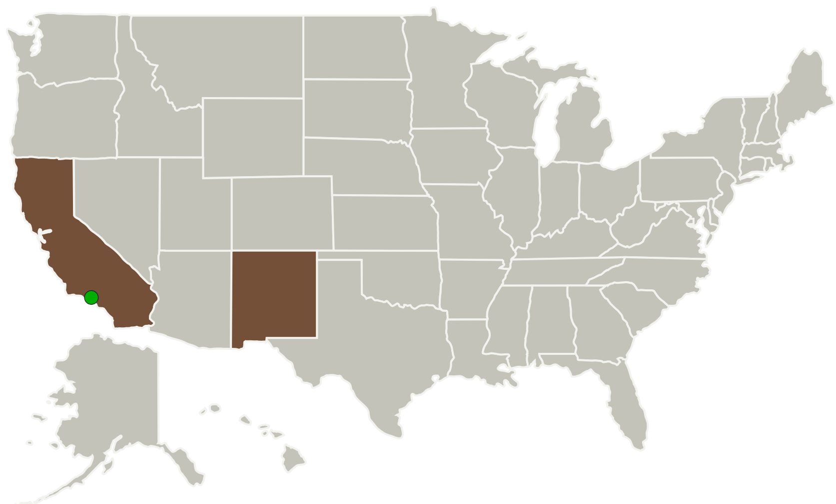
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Goodman Technologies, LLC	Lead Organization	Industry	Albuquerque, New Mexico
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	New Mexico

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139398)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Goodman Technologies, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

William Goodman

Co-Investigator:

William C Goodman

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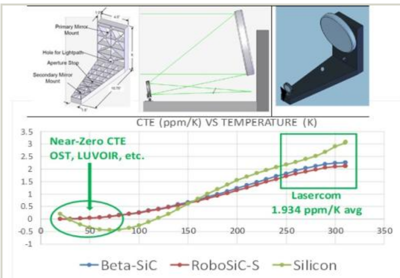
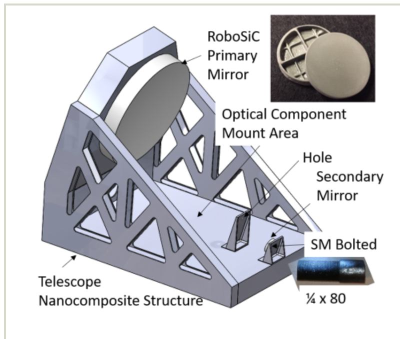
Images



Briefing Chart Image
Ultra-Lightweight, Ultra-Stable RoboSiC Additively Manufactured Lasercom Telescope, Phase I
(https://techport.nasa.gov/image/132233)



Final Summary Chart Image
Ultra-Lightweight, Ultra-Stable RoboSiC Additively Manufactured Lasercom Telescope, Phase I
(https://techport.nasa.gov/image/134334)

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  └ TX05.1 Optical Communications
    └ TX05.1.6 Optimetrics

Target Destinations

Earth, The Moon, Others Inside the Solar System